any gases besides carbonic oxide formed in the experiment. This gas was analyzed by the addition of oxygen and subsequent detonation by the electric spark, the absorption of the carbonic acid by potash, and the removal of the oxygen over by pyrogallate of potash. The results of the analysis entirely concur with the assumption that the 188·6 volumes of gas were constituted of hydrogen, marsh-gas, and formic aldehyde in the proportions given below:—

Hydrogen	183·2
Marsh-gas	0·2
Formic aldehyde	5·2
	188·6

The composition of 100 volumes of the gas being,

Hydrogen	97·14
Marsh-gas	0·10
Formic aldehyde	2·76
	100·00

Another experiment was attended with similar results, only that the proportion of marsh-gas was somewhat greater.

The result of this experiment may be considered to be given in the equation $CO_2+2H_2=COH_2+H_2O$. I have reason to believe that formic aldehyde is also formed in the reaction of hydrogen and carbonic oxide, and that the marsh-gas found (in both experiments) results from the decomposition of this substance, possibly according to the equation $2COH_2=CO_2+CH_4$. I do not now dwell upon this subject, as it is my intention very speedily to lay before the Society, together with other matters, the details of the various experiments which I have made in reference to it.

II. "On the Influence of Brandy on the Bodily Temperature, the Pulse, and the Respirations of Healthy Men." By E. A. Parkes, M.D., F.R.S., Professor of Hygiene, Army Medical School. Received November 29, 1873.

In the Proceedings of the Royal Society (Nos 120, 123, and 136) the details of experiments are given which show that in two healthy men pure ethyl alcohol, brandy, and claret, given at intervals during the day, produced no effect on the temperature of the body as measured in the axilla and rectum.

This result is in accordance with the experiments of several other observers, while there are some experimenters who have noticed a decrease in temperature in healthy men after the use of alcohol. In some cases of disease in men and in some healthy animals alcohol has caused, it would seem, a decided lessening of temperature.

These differences of statement led me to conceive that the time when the alcohol was given might have some effect.

In the experiments formerly reported to the Royal Society, alcohol was usually given either with or at no long interval from food. As food raises the temperature of the body, it occurred to me that it might mask an opposite action of the alcohol; and I therefore determined to repeat the experiments, and to give the alcohol about four hours after a moderate breakfast, when the heating-effect of the food had gone off, and when digestion was completed, and also to give it in a state of complete inanition.

I. *Experiments after the completion of Digestion.*

The subject of the observations is a strong healthy soldier, T. R., aged 25, height 5 feet $8\frac{3}{4}$ inches, weight (naked) 67·46 kilogrammes, or 148 lbs. He has at times drunk some quantity of spirits, but not for the last two or three years, and usually takes about two or three pints of beer daily.

The course of the experiments was as follows:—His breakfast was taken at 6.30, was finished every day by 7 A.M.; he took for breakfast 8 ounces of bread, $\frac{1}{2}$ ounce of butter, and 17 fluid ounces of tea with sugar and with 3 ounces of milk. Immediately after breakfast he went to bed again, and did not get out of the recumbent position for any purpose until 2 o'clock. He then dined on 12 ounces of beefsteak, 4 ounces of bread, and 8 ounces of water.

After dinner he took exercise and smoked, had tea (same food as at breakfast) at 6, and a glass of water at 9 P.M., when he went to bed. He took daily precisely the same diet and quantity of water.

Thermometers (tested for accuracy and exactly corresponding) were placed in the axilla and rectum at 6 o'clock, and, except at breakfast, they were removed only for the purpose of being read at first every 30 and then every 15 minutes, and were at once replaced, until 2 o'clock, after which time the temperatures were only taken every two hours.

After several days' preliminary examination (during which time he took no alcohol) the experiments were commenced and carried on for six days without alcohol; then during five days undiluted brandy containing 50 per cent. of absolute alcohol was given once daily, viz. at 11 A.M., four hours after breakfast.

On the first day one fluid ounce of brandy (=$\frac{1}{2}$ ounce of alcohol) was given, on the second day two ounces, on the third day four ounces, on the fourth day six ounces (=3 ounces of alcohol), and on the fifth day also six ounces. I had intended to give him eight ounces on the fifth day, but the brandy made him so ill, he begged me not to increase the quantity*.

* The effect of the six ounces of brandy taken in this way at one time and without water was entirely to destroy appetite, so that he could not force himself to take his food; it also caused a great feeling of depression, sickness, and headache, and increased the flow of urinary water very largely for three hours. The nitrogenous elimination

Axilla and Rectum Temperatures.

The following Tables give all the thermometric observations under the three periods of 6 A.M. to 11, 11 to 2, and 2 to 10 P.M.

Axilla Temperature (Fahrenheit).

Before Brandy.

Period from 6 A.M. to 11 A.M.

Hours.	Days, June 1873.					
	21.	22.	23.	24.	25.	26.
6 o'clock ...	97·0	97·6	98·4	97·2	97·0	97·0
6.30 „	97·0	97·6	98·4	97·2	97·0	97·0
7 „	97·8	97·8	98·2	97·8	97·4	97·2
7.30 „	97·4	97·8	98·2	98·0	98·0	98·0
8 „	97·2	97·8	98·0	98·0	98·0	98·0
8.30 „	97·0	97·8	98·2	98·8	98·2	98·0
9 „	98·6	97·8	98·2	98·4	98·0	98·0
9.30 „	98·0	97·0	98·2	98·0	98·0	97·8
10 „	98·2	97·4	98·2	98·0	98·0	97·2
10.30 „	98·2	97·6	98·2	98·2	98·0	98·0
11 „	98·2	97·6	98·2	98·0	98·2	97·8
Mean of the period	97·62	97·7	98·22	97·9	97·7	97·6
Period from 11 A.M. to 2 P.M.						
11.15 o'clock...	...	...	98·4	98·2	97·8	97·8
11.30 „	98·5	98·28	...	...	...	...
11.45 „	...	...	98·2	98·0	98·0	97·0
12 „	98·2	97·8	97·9	...	...	97·4
12.15 „	98·1	...	97·9	97·8	98·0	...
12.30 „	98·1	98·0	97·84	97·8	97·6	97·5
12.45 „	...	...	97·84	...	97·5	97·5
1 „	98·0	98·0	97·6	97·8	97·6	97·4
1.15 „	97·6	...	97·8	...	...	97·4
1.30 „	...	98·2	...	97·8	98·0	97·4
1.45 „	97·6	...	97·8	...	...	97·4
2 „	97·6	98·2	97·8	97·8	97·7	97·2
Mean of the period	97·96	98·06	97·9	97·9	97·8	97·4
Period from 2 to 10 P.M.						
3 o'clock...	98·0	...	97·8	97·8	97·9	98·2
4 „	98·6	98·2	97·8	97·8	98·0	98·2
6 „	98·0	98·4	98·6	97·8	98·8	98·4
8 „	98·8	98·2	98·2	98·0	98·8	98·3
10 „	98·7	98·2	98·6	97·8	98·6	98·5
Mean of the period	98·4	98·25	98·25	97·8	98·4	98·3

was not increased, and was probably slightly lessened; but the loss of appetite, which altered the ingress of nitrogen, on one day rendered the experiment rather imperfect. In order not to lengthen the present communication, I reserve all details of the egress of nitrogen and phosphoric acid and alcohol for another opportunity.

Axilla Temperature.

Brandy at 11 A.M.

Period from 6 to 11 A.M.

Hours.	Days, June 27 and July 1, 1873.				
	27.	28.	29.	30.	1.
6 o'clock ...	96·6	97·5	97·0	97·4	96·8
6.30 ,,	96·6	97·2	97·2	97·4	97·0
7 ,,	97·0	97·0	97·2	97·4	97·2
7.30 ,,	97·8	97·2	97·2	97·6	97·2
8 ,,	98·0	97·4	97·2	97·8	97·4
8.30 ,,	98·0	97·4	97·8	98·4	97·4
9 ,,	98·2	98·0	97·8	98·4	98·0
9.30 ,,	98·2	98·4	97·8	98·6	98·0
10 ,,	98·4	98·4	98·2	98·5	98·2
10.30 ,,	98·2	98·4	98·0	98·2	98·4
11 ,,	98·2	98·0	98·0	98·2	98·4
Mean of the period	97·7	97·72	97·58	97·98	97·6
Period from 11 A.M. to 2 P.M.					
11.15 o'clock...	98·0	97·0	98·0	98·2	98·6
11.30 ,,	...	97·2	98·0	97·8	98·4
11.45 ,,	97·8	97·2	97·8	97·3	97·9
12 ,,	...	97·4	97·8	...	98·0
12.15 ,,	97·9	97·2	97·3	97·2	97·7
12.30 ,,	97·8	97·5	97·8	97·1	97·4
12.45 ,,	97·8	97·6	97·8	97·1	97·4
1 ,,	97·8	97·62	97·8	96·82	97·4
1.15 ,,	97·8	97·44	97·8	97·1	97·4
1.30 ,,	97·9	97·5	97·8	96·8	97·4
1.45 ,,	97·8	97·5	97·8	97·1	97·4
2 ,,	97·8	97·5	97·8	97·0	97·4
Mean of the period	97·83	97·4	97·8	97·23	97·4
Period from 2 to 10 P.M.					
3 o'clock ...	98·0	97·6	98·0	98·2	97·6
4 ,,	98·3	98·2	98·0	98·4	98·0
6 ,,	98·2	98·2	98·0	98·4	97·8
8 ,,	98·2	98·4	98·8	98·4	98·4
10 ,,	97·4	97·3	99·0	97·6	97·4
Mean of the period	98·02	97·94	98·3	98·2	97·84

Temperature of Rectum.

Before Brandy.

Period from 6 to 11 A.M.

Hours.	Days, June 1873.					
	21.	22.	23.	24.	25.	26.
6 o'clock ...	97·8	97·8	98·8	97·8	97·4	98·4
6.30 ,,	97·8	97·8	98·8	97·8	97·4	98·4
7 ,,	98·2	98·4	98·8	98·2	97·8	98·4
7.30 ,,	98·8	98·8	99·0	98·6	97·8	98·6
8 ,,	98·8	98·8	99·0	98·8	98·8	98·8
8.30 ,,	99·0	98·8	99·0	99·0	99·0	98·6
9 ,,	99·2	98·8	99·4	99·0	99·0	98·6
9.30 ,,	99·2	99·2	99·2	99·0	98·8	98·6
10 ,,	99·2	98·8	99·2	98·8	98·8	98·6
10.30 ,,	98·9	99·0	98·8	99·0	98·8	98·8
11 ,,	98·4	98·8	98·4	98·8	98·8	98·6
Mean of the period	98·67	98·6	98·96	98·6	98·5	98·6
Period from 11 A.M. to 2 P.M.						
11.15 o'clock	...	...	99·0	99·0	98·8	98·8
11.30 ,,	99·0	98·62	...	...	98·8	...
11.45 ,,	...	...	99·1	99·0	...	98·8
12 ,,	99·1	98·8	99·0	...	...	98·6
12.15 ,,	99·0	...	99·0	99·0	98·8	...
10.30 ,,	99·2	98·6	98·8	98·8	98·6	98·6
12.45 ,,	...	...	98·8	...	98·2	98·5
1 ,,	99·0	98·6	98·8	98·6	98·4	98·5
1.15 ,,	98·8	...	98·8	...	...	98·5
1.30 ,,	...	99·2	...	98·4	98·4	98·5
1.45 ,,	98·8	...	98·8	...	...	98·5
2 ,,	98·8	99·0	98·8	98·4	98·5	98·2
Mean of the period	98·96	98·8	98·88	98·74	98·6	98·56
Period from 2 to 10 P.M.						
3 o'clock	99·4	...	99·4	99·0	98·8	98·8
4 ,,	99·5	99·6	99·8	99·2	98·8	99·6
6 ,,	100·4	100·2	99·6	99·2	99·4	100·2
8 ,,	100·8	100·6	100·4	99·2	99·6	100·0
10 ,,	100·65	100·6	99·6	99·4	100·2	100·4
Mean of the period	100·14	100·25	99·76	99·2	99·36	99·8

Temperature of Rectum.

During Brandy.

Period from 6 to 11 A.M.

Hours.	Days, June 27 to July 1, 1873.				
	27.	28.	29.	30.	1.
6 o'clock	97·6	98·4	98·0	98·0	97·4
6.30 ,,	97·6	98·4	98·4	98·0	97·6
7 ,,	98·0	98·2	98·4	98·2	98·2
7.30 ,,	98·4	98·4	98·4	88·2	98·2
8 ,,	98·6	98·6	98·4	98·4	98·8
8.30 ,,	98·6	98·6	98·4	99·4	98·8
9 ,,	99·0	99·0	98·4	99·2	98·8
9.30 ,,	99·0	99·0	98·4	99·4	98·8
10 ,,	98·8	98·8	98·8	99·2	99·2
10.30 ,,	98·8	98·8	98·7	99·2	99·4
11 ,,	98·8	98·8	98·7	99·0	99·2
Mean of the period	98·4	98·64	98·45	98·7	98·5
Period from 11 A.M. to 2 P.M.					
11.15 o'clock	99·4	98·8	98·8	99·2	99·4
11.30 ,,	99·4	98·6	99·6	99·0	99·4
11.45 ,,	99·4	98·6	98·8	98·6	99·3
12 ,,	99·0	98·6	98·8	98·6	99·0
12.15 ,,	99·0	98·4	98·8	98·5	98·8
12.30 ,,	99·0	98·4	98·6	98·2	98·6
12.45 ,,	99·0	98·4	98·6	98·2	98·6
1 ,,	98·9	98·4	98·6	98·0	98·6
1.15 ,,	98·9	98·3	98·6	98·2	98·6
1.30 ,,	98·9	98·3	98·6	98·0	98·6
1.45 ,,	98·9	98·3	98·6	98·0	98·6
2 ,,	98·8	98·3	98·6	97·7	98·6
Mean of the period	99·05	98·45	98·75	98·35	98·84
Period from 2 to 10 P.M.					
3 o'clock	99·4	99·0	98·8	98·4	98·6
4 ,,	99·2	99·5	99·6	99·2	98·8
6 ,,	99·6	99·4	100·6	99·8	100·4
8 ,,	99·4	99·0	100·8	100·6	101·0
10 ,,	99·8	98·6	100·6	98·8	99·0
Mean of the period	99·2	99·1	100·1	99·28	99·56

These observations will now be considered under the three following heads :—

1st. The mean temperature of the day.

2nd. The mean temperature of the periods.

3rd. The range of the thermometer from 11 to 2 o'clock; *i. e.* the difference between the 11 o'clock and the 2 o'clock temperatures.

1. *Mean Temperature of the fourteen hours when the man was under observation.*

144 observations in the water days give a mean daily temperature in the axilla of 97°·9, and 137 observations in the brandy days give a mean daily temperature of 97°·71. In the rectum the observations were 144 and 138 respectively, giving a mean daily rectum temperature of 98°·89 in the non-brandy and 98°·78 in the brandy days.

This difference is so slight as to fall within the range of unavoidable error; but it might be that the effect of the brandy was only perceptible for a short time. It is necessary then to take the temperature of the periods.

2. *Mean Temperature of the Periods.*

	Mean axilla temperature.	
	Before brandy.	During brandy.
Period from 6 A.M. to 11 A.M. ...	97°·82	97°·73
No. of observations giving mean	66	55
Period from 11 A.M. to 2 P.M. ...	97°·79	97°·58
No. of observations giving mean	49	57
Period from 2 P.M. to 10 P.M. ...	98°·25	98°·05
No. of observations giving mean	29	25

	Mean rectum temperature.	
Period from 6 A.M. to 11 A.M. ...	98°·63	98°·57
No. of observations giving mean	66	55
Period from 11 A.M. to 2 P.M. ...	98°·73	98°·68
No. of observations giving mean	49	58
Period from 2 P.M. to 10 P.M. ...	99°·73	99°·46
No. of observations giving mean	29	25

The differences, especially in the case of the rectum mean temperatures, are slight even in the hours between 11 and 2. In every case, however, the mean of the thermometer is lower, though to a very slight extent, in the alcoholic series. This, however, is not conclusive, as will be evident from a consideration of the mean rectum temperatures on the several days.

Mean Temperature of Rectum in the three hours following brandy.

No Brandy.		Brandy.	
1st day	98·96	1st day	99·05
2nd ,,	98·80	2nd ,,	98·55
3rd ,,	98·88	3rd ,,	98·75
4th ,,	98·74	4th ,,	98·34
5th ,,	98·60	5th ,,	98·84
6th ,,	98·56		

On four of the brandy days the mean temperatures were quite equal to four of the non-brandy days; on one day (6 ounces of brandy) the mean was, however, only 98°·34, or 0°·22 below the lowest temperature of a water day. But this was accidental, and was owing to the thermometer getting imbedded in a mass of fæces, which separated it from the intestinal wall. For fear of spoiling the experiment, the man would not move though he greatly wished to do so. That this was the real cause of the diminution in this mean, is shown by the last day's experiment, when with the same quantity of brandy the temperature was higher than on four of the water days, and was 0°·1 above the mean of the six water days. It seems therefore very difficult to conclude from the mean rectum temperature of the period that there was an actual fall.

In the period from 2 to 10 the mean brandy temperature was 0°·27 lower than in the water period. But as the observations were much fewer at this time and were taken at much longer intervals, and as food and exercise complicated the results, little importance can be attached to them.

Although the mean temperatures do not, then, give a satisfactory answer to the inquiry, it may be that an effect may be found in the initial and terminal temperatures of the 11 to 2 period. This is shown in the following Table:—

3. *Range of the Temperature from* 11 *to* 2 *o'clock.*

Axilla Temperatures.

Temperature.	Water Period. Days.						Brandy Period. Days.				
	1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.
At 11 o'clock ...	98·2	97·6	98·2	98·0	98·2	97·8	98·2	98·0	98·0	98·2	98·4
At 2 o'clock ...	97·6	98·2	97·8	97·8	97·7	97·2	97·8	97·5	97·8	97·0	97·4
Difference	−·6	+·6	−·4	−·2	−·5	−·6	−·4	−·5	−·2	−1·2	−1·0
Rectum Temperatures.											
At 11 o'clock ...	98·4	98·8	98·4	98·8	98·8	98·8	98·8	98·8	98·7	99·0	99·2
At 2 o'clock ...	98·8	99·0	98·8	98·4	98·5	98·2	98·8	98·3	98·6	97·7	98·6
Difference	+·4	+·2	+·4	−·4	−·3	−·6	...	−·5	−·1	−1·3	−·6

The greatest fall in these three hours of the axilla temperature on a water day was 0°·6 Fahr.: the greatest fall on a brandy day was 1°·2, and on another day the fall was 1°, or ·6 and ·4 more than on any water day; yet on the third day of brandy, when four fluid ounces (=2 fluid ounces of absolute alcohol) were taken, the difference was only 0°·2 Fahr.

In considering the rectum temperatures it is necessary to omit the fourth day of brandy, when impacted fæcal matter in the bowel evidently lowered the reading of the thermometer. There was no fall with one fluid ounce of brandy (=½ fluid ounce or 14 cub. centim. of alcohol), a fall of 0°·5 with two fluid ounces (=28·4 cub. centims. of alcohol), of only 0°·1 with four fluid ounces, and of 0°·6 with six fluid ounces. There was therefore no regularity with the increasing quantity of brandy. The greatest fall (0°·6) was not more than occurred on one of the water days.

When these numbers, omitting the fourth brandy day of the rectum series, are submitted to calculation according to the rule given by Mr. Galloway in his Treatise on Probability, the following results are given:—

Difference of Temperature between 11 and 2 o'clock in Fahrenheit degrees.

	Axilla temperature.		Rectum temperature.	
	Water days.	Brandy days.	Water days.	Brandy days.
No. of observations	6	5	6	4
Mean difference	−0°·28	−0°·66	−0°·05	−0°·3
Probable error of result	±0°·115	±0°·114	±0°·11	±0°·07
Truth lies between ...	−0°·395 −0°·175	−0°·774 −0°·546	−0°·16 +0°·06	−0°·37 −0°·23

If the observations are not too few to be trusted, this calculation shows that there was a slight fall in temperature in the three hours following brandy.

But it will be seen at once both how small the fall is, and how difficult it is even yet to feel quite sure of the result. Taking the rectum temperature for example, the probable errors of result as calculated out are 0°·11 in the water and 0°·07 in the brandy days; the results in each series might then have been a mean fall of −0°·16 in the water series and of −0°·23 in the brandy series, or there might have only been a difference of −0°·07.

Still, looking at all these results, and especially to the fact that the calculation is in all cases a little against the brandy series, it may be concluded that in this man the brandy did produce a very slight fall; but that, if this is correct, the fall could not have been more than 0°·35 Fahr., and may have been only ·07 Fahr., in three hours.

It may probably be interesting to note the usual course of the bodily temperature in the water period. It was very uniform: at 6 A.M. (twelve hours after food) the mean rectal temperature was lowest, viz. 98°; and it was highest at 10 at night, when it reached 100°·14, or a difference in the twenty-four hours of 2°·14 Fahr.

From the effect produced by the breakfast, I infer that this course was chiefly owing to food, and not to any peculiar effect produced by the time of day.

Thus the mean rectum temperature being 98° at 6 and 6.30 o'clock A.M., it rose at 7 (just after a warm breakfast) to 98°·3, and continued to rise till 9 o'clock, when it reached 99°. It continued at this point until 10 or 10.30, when it began to fall, and at 11 was 98°·66, at 1 98°·65, and at 2 o'clock 98°·62. Then dinner and exercise were taken, and the thermometer went rapidly up, being 99°·08 at 3 o'clock, 99°·42 at 4, 99°·83 at 6, 100°·10 at 8, and 100°·14 at 10. It seems fair to attribute this rise especially to the effect of food.

The mean axilla temperature followed exactly the same course, being lowest (97°·36) at 6 A.M., rising after breakfast, falling again three and three and a half hours after breakfast, and rising immediately after dinner and tea to its highest point, 98°·4; the mean diurnal difference in the axilla temperature was one half that of the rectal, or 1°·04*.

The Pulse.

The pulse was taken on an average twenty-three times daily, from six in the morning until ten at night, the man being always in a recumbent position, and, in fact, being in bed until two o'clock every day. The course of the pulse before the brandy was taken was very constant; the number of beats per minute was raised by breakfast for two hours, then fell gradually until dinner, and then rose greatly after dinner in consequence of the food and exercise.

The following are the averages of the days:—

Days.	Before Brandy.	During Brandy.
1	76·3	75·4
2	79·9	73·3
3	77·0	77·2
4	77·2	77·2
5	72·6	73·9
6	71·8	
Average of the whole water period		75·67
„ „ brandy „		75·47

* It may be noticed, in reference to the rectum temperature, that it is not quite correct to say, as is sometimes done, that there is no change within short periods. In half an hour the rectum temperature has varied as much as 0°·4 Fahr., though I took every precaution to place the thermometer properly and to read it with great care. Usually it is much less than this. The variations within short periods in the axilla were, however, decidedly greater than in the rectum, but were seldom more than from 0°·6 to 0°·8 as a maximum.

It will be observed that, when all the days are taken, the brandy did not raise the mean pulse of the whole day. It increased, however, the rapidity of the pulse during the three hours after it was taken, as will be seen from the following Table:—

Mean of the hours from 11 to 2 o'clock.

Days.	No Brandy.	Brandy.
1	67·0	69
2	71·6	67·7
3	66·9	79·8
4	64·8	71·1
5	63·0	71·1
6	61·0	
Mean.....	65·7	71·7

The quickening of the pulse during these hours is best seen by taking two days, which are fair samples of the series.

Record of two days, one without and one with brandy (6 ounces), to show the influence of food, of movement, and of brandy.

Hours.	Beat of Pulse.		Hours. (continued).	Beat of Pulse.	
	No Brandy.	Brandy at 11 o'clock (6 ounces).		No Brandy.	Brandy at 11 o'clock (6 ounces).
6 A.M.	65	65	12.15 P.M.	...	72
6.30	65	65	12.30	...	69
7 (breakfast)	65	64	12.45	64	69
7.30	67	66	1	62	67
8	84	82	1.15	62	67
8.30	85	93	1.30	61	65
9	84	90	1.45	61	65
9.30	73	85	2	60	70
10	66	75			
10.30	69	74	Mean of period	61·6	71·25
11	68	74			
			3	98	94
Mean of period	72	76	4	94	98
			6	92	99
11.15	62	76	8	94	95
11.30	...	82	10	82	88
11.45	62	80			
12 (noon)	60	73	Mean of period	92	95

As the means of the entire day are practically the same when all the days are taken, it is clear that the acceleration of the pulse in the three hours succeeding the taking of the brandy must have been compensated by a corresponding lessening of frequency afterwards; and this is shown by the following Table:—

	Pulse.		
	Period from 6 to 11 A.M.	Period from 11 A.M. to 2 P.M.	Period from 2 to 10 P.M.
Mean of six days, without brandy	77·2	65·7	88·9
Mean of five days, with brandy ...	74·2	71·7	87·0

In the brandy period the mean pulse was 1·9 per minute slower in the after part of the day, and three beats per minute slower in the morning. The action of the single small dose of brandy in the day was to alter the mode of working of the heart, and not to alter the amount of work done in 24 hours, as far as this was judged of by the frequency of the pulse. As far as frequency was concerned the compensation was perfect, and the temporary quickening was balanced by an equal amount of subsequent retardation. Previous experiments indicated that when large and repeated doses were taken, the acceleration was not thus compensated, and that the heart beat more frequently than was natural throughout the whole day. It was certainly very interesting to see how this healthy heart maintained its balance, and, in spite of the alteration in action forced upon it, accomplished in the day the same amount of work under different conditions of diet. Whether other healthy, and especially whether diseased, hearts would do the same is an interesting question, as is also the point whether the temporary acceleration was, in this man, useful, or hurtful, or indifferent, to the heart.

Respiration.

The respirations were taken at the same time as the pulse, and there were twenty-three daily observations. To save space I give only the mean numbers.

Respirations.

Mean number per minute.

Before Brandy.

Period.	Days, June 1873.					
	21.	22.	23.	24.	25.	26.
6 to 11 A.M.	23·3	24·0	20·8	21	21	22
11 A.M. to 2 P.M.	21·7	23·3	19·1	19	18	18
2 to 10 P.M.	24	23·25	23	22	23	23

During Brandy.

Period.	Days, June 27 to July 1, 1873.				
	27.	28.	29.	30.	1.
6 to 11 A.M.	21	20	20·1	21	19
11 A.M. to 2 P.M.	18·3	17·8	20·7	16·66	15·9
2 to 10 P.M.	22	21	21	21·4	23

The respirations in this man were always extremely quick, even when he had been lying in bed for eighteen hours. The variation follows closely the changes in the pulse. They increased after breakfast at 7 o'clock, and then at 9.30 commenced to fall, and continued less numerous by two or three per minute until dinner. This meal, and the exercise which was always taken in the afternoon, raised the number. The brandy seemed to lessen the number of respirations in the period from 11 to 2 o'clock; the mean of this period in the anti-brandy days was 19·86 per minute, and in the brandy period was 17·88. This result, if it be real, showed a difference between the pulse and respirations, the former being raised six beats per minute on a mean of all the days, and the latter being lowered two respirations per minute in the three hours following the brandy. The effect on the number of respirations was most marked in the two days when six ounces of brandy was taken.

Considering, however, the rather unusual frequency of the respirations in the man and the smallness of the change, I hesitate to conclude that the respirations were lessened in number, but decidedly they were not increased.

Received February 5, 1874.

II. *Experiments during complete Inanition.*

The following experiments were made to determine the effect of alcohol after sixteen hours fasting:—

A healthy man (J. S.), 5 ft. 4 in. in height, weighing 66·774 kilogrammes, was kept in bed every day until 1 o'clock, at which time he received his first meal in the day. The last meal was taken at 6 o'clock P.M. He was consequently fasting for nineteen hours. The axilla and rectum temperatures were taken every half hour from 6 to 10 A.M., and every fifteen minutes from 10 to 1 P.M., the thermometers remaining *in situ*, except for the purpose of being read. The daily food was the same, except on two days, when the brandy destroyed his appetite and he could not quite eat his ration.

The experiments were carried on for six days: on the first, third, and fifth days he took no alcohol; on the second, fourth, and sixth days he took 6 fluid ounces of brandy, containing 36 per cent. of alcohol, at 10 o'clock; he therefore took 2·16 fluid ounces, or 61 cub. centims., of absolute alcohol sixteen hours after taking food. The following Tables give the results.

Temperature of Axilla.

Time.	Days.					
	1.	2.	3.	4.	5.	6.
6 o'clock A.M...	.....	97·4	96·8			
6.30 ,,	98·0	97·4	96·8	97·0	97·5	97·1
7 ,,	97·0	97·4	97·0	96·6	97·5	97·2
7.30 ,,	97·4	97·4	97·0	96·2	97·7	97·0
8 ,,	97·0	97·3	97·1	96·8	97·8	97·2
8.30 ,,	96·2	97·6	97·4	97·0	97·4	97·1
9 ,,	96·6	97·4	97·45	96·6	97·2	97·2
9.30 ,,	97·1	97·5	97·2	96·8	97·2	97·0
10 ,,	96·9	97·8	96·7	97·2	97·2	97·4
Mean	97·025	97·46	97·05	96·77	97·43	97·15
		6 ounces of brandy.		6 ounces of brandy.		6 ounces of brandy.
10.15 o'clock A.M...	96·2	98·0	97·0	97·2	97·2	96·8
10.30 ,,	96·8	97·6	.....	96·6	96·9	97·2
10.45 ,,	97·0	97·6	97·2	97·0	97·4	97·1
11 ,,	97·8	97·75	97·6	96·4	97·5	97·1
11.15 ,,	97·6	97·3	97·4	96·4	97·2	97·1
11.30 ,,	97·8	97·6	97·4	96·4	97·5	97·1
11.45 ,,	97·7	97·6	97·4	96·8	97·6	97·2
12 ,,	98·4	97·5	97·35	96·65	97·6	97·3
12.15 o'clock P.M...	98·0	97·4	97·2	96·6	97·4	97·05
12.30 ,,	97·8	97·6	97·7	96·6	97·2	97·1
12.45 ,,	98·3	97·6	97·4	96·6	97·4	97·1
1 ,,	97·6	97·6	97·5	96·6	97·4	97·4
Mean	97·58	97·59	97·38	96·654	97·36	97·13
2 o'clock P.M.....	98·4	97·85	98·2	97·0	98·4	97·0
4 ,,	98·4	98·1	98·1	97·6	98·6	98·0
6 ,,	99·0	98·6	98·44	98·2	98·6	98·4
8 ,,	98·6	98·45	97·8	98·4	97·8	98·0
10 ,,	98·0	98·2	96·8	97·89	97·4	97·4
Mean	98·48	98·24	97·87	97·82	98·16	97·84

Temperature of Rectum.

Time.	Days.					
	1.	2.	3.	4.	5.	6.
6 o'clock A.M...	.....	98·4	97·8			
6.30 ,,	97·4	98·4	97·8	97·8	97·9	97·9
7 ,,	98·2	98·4	98·4	97·8	97·9	97·9
7.30 ,,	98·2	98·4	98·4	98·0	98·0	97·8
8 ,,	98·4	98·6	98·4	98·0	97·9	97·9
8.30 ,,	98·4	98·6	98·4	98·2	98·2	97·6
9 ,,	98·4	98·4	98·2	98·0	98·4	97·7
9.30 ,,	98·4	98·4	98·1	98·2	98·3	97·9
10 ,,	98·2	98·4	98·2	98·4	98·4	98·1
Mean	98·2	98·44	98·19	98·05	98·12	98·1
		6 ounces of brandy.		6 ounces of brandy.		6 ounces of brandy.
10.15 o'clock A.M...	98·3	98·6	98·2	98·25	98·4	98·2
10.30 ,,	98·4	98·5	98·2	98·3	98·4	98·0
10.45 ,,	98·9	98·4	98·3	98·2	98·4	97·9
11 ,,	98·8	98·5	98·35	97·8	98·3	97·6
11.15 ,,	99·0	98·2	98·2	97·5	98·3	97·7
11.30 ,,	98·9	98·2	98·3	97·4	98·4	97·6
11.45 ,,	99·0	98·2	98·3	97·4	98·4	97·6
12 o'clock P.M...	99·0	98 2	98·3	97·4	98·4	97·6
12.15 ,,	99·0	98·25	98·3	97·4	98·4	97·9
12.30 ,,	99·0	98·3	98·3	97·4	98·4	97·8
12·45 ,,	99·0	98·4	98·4	97·4	98·4	97·8
1 ,,	99·0	98·4	98·6	97·5	98·4	97·8
Mean	98·833	98·346	98·31	97·66	98·38	97·8
2 o'clock P.M.....	99·8	99·4	99·3	98·6	99·4	98·8
4 ,,	100·2	98·7	99·3	98·2	99·6	98·8
6 ,,	99·6	99·4	99·8	99·2	99·8	100·0
8 ,,	99·8	99·4	99·6	99·4	98·8	99·4
10 ,,	99·0	99·2	98·4	98·8	98·6	98·4
Mean	99·68	99·22	99·28	98·84	99·24	99·08

If the rectum temperatures, as being the safest, are alone regarded, the following are the mean daily temperatures :—

	Days.					
	1.	2. 6 ounces of brandy.	3.	4. 6 ounces of brandy.	5.	6. 6 ounces of brandy.
Mean rectum temperature	98·8	98·546	98·45	98·02	98·47	98·14

The mean of the three water days was 98·57, and of the three days with brandy 98·24.

There appears, then, to be a slight fall on the brandy days. On reference to the larger Table giving the means of the periods, it will be also noticed that in the periods from 10 to 1 in the three hours immediately succeeding the brandy, the rectum temperature was not only lower in two of the brandy periods, but sank twenty-six times to 98°·2 or below it, and on one day sank to 97°·4 for more than an hour; while in the corresponding periods without brandy, which include an equal number of observations, it only sank three times as low as 98°·2, and never fell below this. In other words, out of nine hours when brandy was taken, the temperature was at 98°·2, or below it, during $5\frac{3}{4}$ hours, while in other 9 hours without brandy, at the same time of the day, the temperature was at 98°·2 only for $\frac{3}{4}$ of an hour, and was never lower. This seems conclusive; for whatever conditions, independent of food and movement, may cause slight alterations in temperature (and the Tables show such conditions do act), it seems impossible they should have acted twenty-six times out of thirty-six when alcohol was taken, and only three times out of thirty-six when alcohol was not taken.

On tracing the rectum temperatures on the several days from 6 A.M. to 1 P.M., the fall after alcohol is well marked on the fourth day, and is quite perceptible on the sixth day, while on the second day it is only obvious for an hour, and is not great. The explanation of this want of uniformity may perhaps be that the processes in the body causing variations of temperature may sometimes act in the same direction with alcohol and sometimes in the opposite, or, in other words, may sometimes increase the fall and sometimes counteract it.

With regard to the amount of fall, the lowest rectum temperature on the fourth day, when the effect of alcohol was most marked, was 97°·4, while in the hours on the same day before alcohol the lowest was 97°·8. If the effect of alcohol is measured by this difference, it amounts to 0°·4 F.; if it is measured by the difference in the means of the two periods, it amounts to 0°·39 Fahr. It seems fair to assume that 2·16 fluid ounces, or 61 cub. centims., of absolute alcohol produced a mean depression equal to $\frac{4}{10}$ of a degree Fahr. during three hours after alcohol was taken.

The Pulse and Respirations.

The pulse in this man was raised in frequency about five beats per minute by the brandy, as will be seen from the following Table, where the means of the periods only are given to save room.

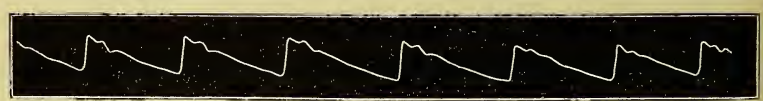
Mean pulse.	Days.					
	1.	2. Brandy at 10.	3.	4. Brandy at 10	5.	6. Brandy at 10.
From 6 to 10 A.M., 8 observations on each day.....	51·25	55·88	46·77	47·9	47·25	48·75
From 10 A.M. to 1 P.M., 12 observations on each day.....	53·91	59·85	46·1	51·91	46·17	56·08
From 1 to 10 P.M., 5 observations on each day.....	67·8	76	59	65·6	66·2	70·2

Sphygmographic tracings were taken for me very carefully by Dr. Hewett, Surgeon R.N., every hour; and forty-two were taken in all. I annex a few tracings, which show the increased force of the heart and the relaxations of the arterial coats.

20th January.

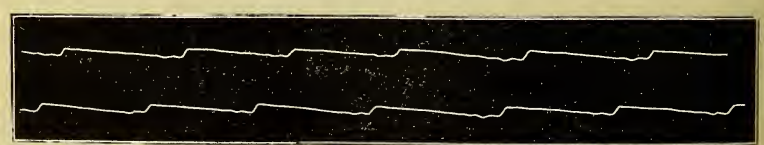
Tracing at 9.30 A.M., 15½ hours after food, and during rest. Pulse 52. Respirations 15.

Tracing at 11 A.M. on the same day, during rest, 1 hour after 6 fluid ounces of brandy, 17 hours after food. Pulse 59. Respirations 11.

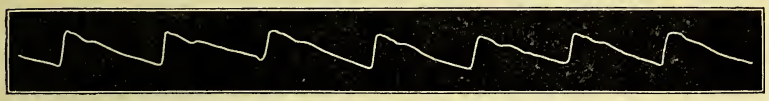


22nd January.

Tracing at 9.30 A.M., 15½ hours after food, and during rest. Pulse 49. Respirations 12.



Tracing at 11 A.M. on the same day, 1 hour after 6 fluid ounces of brandy, but with no food for 17 hours. Body at rest. Pulse 58. Respirations 9.



Tracing at 12.30 on the 21st January, 18½ hours after food. No brandy. To show the effect of fasting. Pulse 48. Respirations 11.

The respirations were slightly lessened in number.

General Conclusions.

I believe the following conclusions may be drawn from the observations formerly recorded (Proceedings of the Royal Society, Nos. 120, 123, and 136) and from those now laid before the Royal Society.

1. When brandy in dietetic doses (=2·16 fluid ounces, or 61 cub. centims., of absolute alcohol) was given to a healthy man fasting and at rest, a decided, though slight lowering, of bodily temperature (as judged of by the heat of the rectum) was caused. The amount of lowering was under ½ a degree of Fahrenheit; and sometimes even this amount was not perceptible, being probably counteracted by the opposing influence of the heat-producing changes in the body, which cause slight variations of temperature independent of food and movement. The greatest effect was produced from about one to two hours after the alcohol was taken, and the effect was evidently passing off in three hours.

2. When brandy in dietetic doses was given to a healthy man at rest and in whom the process of digestion was completed, and whose temperature raised by the food was again commencing to fall, a lessening of temperature was also proved, but its amount was not so great; it could not have been more than 0°·35 Fahr., and may have been only 0°·07 Fahr.

3. When alcohol was given with food, with either usual or increased exercise, no effect on temperature was perceptible, even though the alcohol was given in large quantities, viz. from 4 to 8 fluid ounces of absolute alcohol (114 to 227 cub. centims.) in twenty-four hours. It is to be presumed that the amount of heat generated from the food and movement concealed the effect of the alcohol, which would require a more delicate method or longer observations for detection.

4. In no case did alcohol raise the temperature.

5. The effect of alcohol on the pulse was uniform in the four men experi-

mented upon. The contractions of the heart were more frequent after alcohol during complete rest, from five to ten beats per minute for some time; and when exercise was taken the increase was greater. The mean pulse of the twenty-four hours was, however, not increased unless the amount of alcohol was large and repeated. In other words, the heart's beats were less frequent than natural when the effect of the alcohol had passed off. The pulse became both fuller and softer to the touch; and this relaxation of the radial artery was shown also by the sphygmograph. That the smaller vessels were relaxed, was shown both by the redness of the surface and by the evident ease with which the blood traversed the capillaries, as shown by the sphygmographic tracings.

6. The respirations were not increased in number by alcohol; they were rather lessened, and were deeper in some of the experiments; but the effect was not very marked.

III. "Experimental Demonstrations of the Stoppage of Sound by partial Reflections in a non-homogeneous Atmosphere." By John Tyndall, D.C.L., LL.D., F.R.S., Professor of Natural Philosophy in the Royal Institution.

(See Paper read Jan. 15, *antè*.)

IV. "On the Division of a Sound-Wave by a Layer of Flame or heated Gas into a reflected and a transmitted Wave." By John Cottrell, Assistant in the Physical Laboratory of the Royal Institution. Communicated by Professor Tyndall, F.R.S. Received February 2, 1874.

The incompetency of a sound-pulse to pass through non-homogeneous air having been experimentally demonstrated by Dr. Tyndall, and proved to be due to its successive partial reflections at the limiting surfaces of layers of air or vapour of different density, further experiments were conducted in order to render visible the action of the reflected sound-wave.

The most successful of the various methods contrived for this purpose consists of the following arrangement. A vibrating bell contained in a padded box was directed so as to send a sound-wave through a tin tube, B A (38 inches long, $1\frac{3}{4}$ inch diameter), in the direction B F', its action being rendered manifest by its causing a sensitive flame placed at F' to become violently agitated.

The invisible heated layer immediately above the luminous portion of an ignited coal-gas flame issuing from an ordinary bat's-wing burner